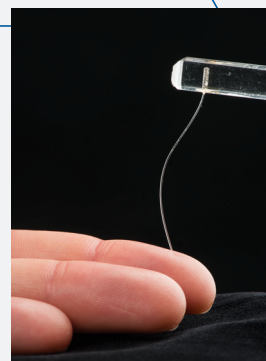
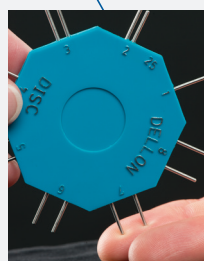




NATIONAL ASSESSMENT MANUAL

For assessment of hand function after nerve repair



Documentation of hand function after nerve repair according to Rosen score, compiled in 2015 through collaboration between the Regional Hand Rehabilitation Units in Stockholm and Malmö, Sweden.

Aim

Our aim in writing this manual has been to promote the use of evidence-based methodology for the assessment of hand function following nerve repair in HAKIR and to create a Swedish standard for the clinical evaluation.

HAKIR

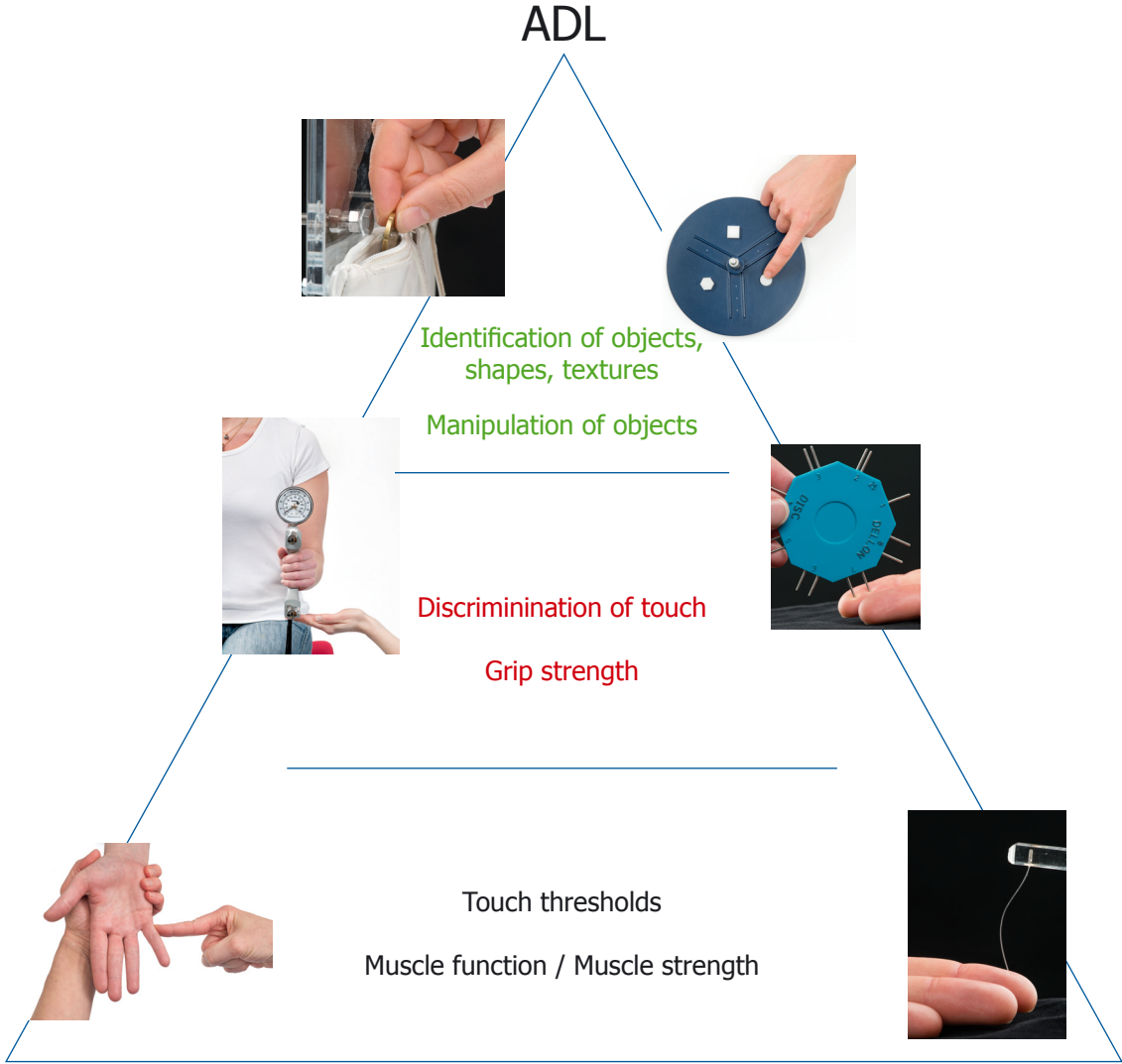
HAKIR is the national quality registry for hand surgery in Sweden. For more information about the registry please see www.hakir.se.

If you have any questions or comments regarding the manual, please contact Birgitta Rosén (e-mail: birgitta.rosen@med.lu.se).

The manual and PDF files (raw-data protocol and protocol for Rosen score) are available at www.hakir.se and will be revised on an annual basis.

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Documentation of hand function after nerve repair – Rosen score



Hierarchy for assessment of hand function after nerve injury. Modified from Fess (1994)¹ and Jerosch-Herold (2005)²

The documentation is based on a standardised test battery^{3,4,5}.

Material required:

- PDF files: Raw-data protocol and protocol for Rosen score
- Semmes-Weinstein monofilament (pocket version)
- Disk Criminators™
- STI-test™
- Mini Sollerman test or original Sollerman test (task no. 4, 8, 10)
- Jamar dynamometer
- Calculator

Preparation

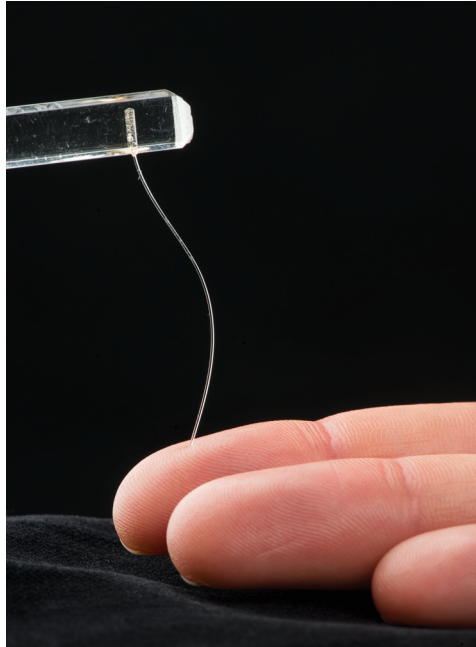
The testing should be done in a quiet room. A screen should preferably be used for the sensory tests; otherwise the patient must have his/her eyes closed. For consistency, the same method of blinding should be used on every test occasion.

During the passive sensory testing (SWM, S2PD), the patient's hand should be resting comfortably in a supine but not too extended position, e.g. on a soft pillow. During active sensory testing (STI test), the patient's hand must be able to move freely.

1. In, for example, "sensory innervation", the results from the monofilament test in the marked critical sites for the relevant nerve (median nerve: tip of digit I, II, and base phalanx of digit II; ulnar nerve: tip and base of digit V and base of hypothenar) are quantified 0–5 according to instructions in the "Instrument and quantification" column. The results are summarised and divided by the normal value. All normal values are given in the "Instrument and quantification" column. The quotient is inserted into the "Score" column for each follow-up occasion. The maximum score for each assessment is 1.00 (two decimal places). The scoring for all assessments is done using the same procedure.
2. Since the three domains (Sensory, Motor, Pain/discomfort) do not contain an identical number of assessment instruments, the mean score for each domain is calculated. The full score for each domain is 1.00 (two decimal places).
3. The mean scores from the three domains are finally summarised as a "total score", and the maximum score is therefore 3.0 (one decimal place). The "total score" is noted at the bottom of the "Scoring key" column and is also transferred to the graph to give visual feedback.

SENSORY INNERVATION

Touch thresholds



Semmes-Weinstein monofilaments ⁶
(pocketversion with 5 filaments)

Material

Apart from the monofilaments, coloured pens (green, blue, purple, and red) are required. The colours represent the functional interpretation of the microfilaments and can be used in the raw-data protocol⁶.

The original version of Semmes-Weinstein monofilaments contains 20 filaments – from 8 mg to 300 g, but in most clinical assessment situations it is sufficient to use the 5 pocket filaments, which cover the entire pressure range –from 70 mg to 300-450 g.

Filament no.	Grams		
2.83	0,07	Green	Normal perception of light touch
3.61	0,4	Blue	Diminished perception of light touch
4.31	2	Purple	Diminished protective sensation
4.56	4	Red	No protective sensation
6.65	450	Red	Perception of deep pressure
		Striped red	Cannot be tested with SW monofilament

Test procedure

The test results are initially inserted into the raw-data protocol.

The filaments are applied perpendicular to the skin 3 times at the highest spot of the finger pulp, and they should bend when applied (see photograph page 6). Apply for 1.5 s with an equally long pause between the three applications.

Start the test distally. Apply the filaments to the areas of the hand that are indicated in the raw-data protocol. The patient says "feel" when he/she feels the touch (which does not have to be localised). Note a positive response in the area in the raw-data protocol if the patient answers within 3 seconds of the application.

Start with filament no. 2.83. Show the patient the filament to emphasise that it is a very light touch that requires full concentration to feel. Demonstrate on a finger with normal feeling.

To ensure that the patient is fully concentrated on the task, the examiner can randomly go back to areas with normal feeling during the test procedure. Mark with the green pen the areas where filament no. 2.83 is felt. Continue with filament no. 3.61 in the areas where the lighter filament was not felt. Mark with blue pen. Continue the testing in the unmarked areas, with filaments 4.31 (purple), 4.56 (red), and 6.65 (red). If the heaviest filament (6.65) is not felt, the area is marked with striped red.

Scoring/Quantification

Should be filled in using the Rosen score document

0 poäng = Not testable

1 poäng = SWM 6.65

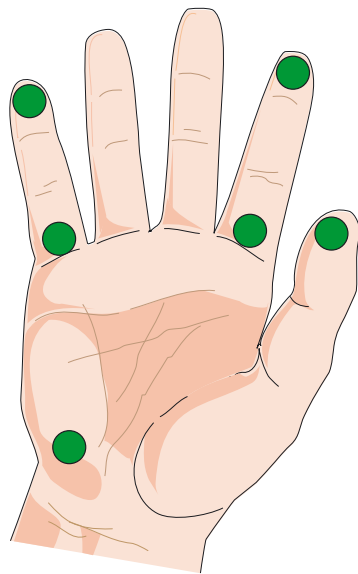
2 poäng = SWM 4.56

3 poäng = SWM 4.31

4 poäng = SWM 3.61

5 poäng = SWM 2.83

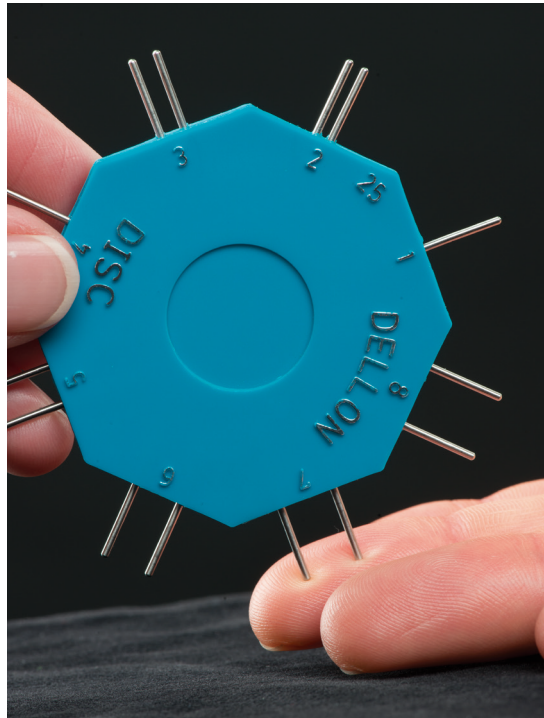
Divide the result achieved from the three "critical sites" (0–15) by the normal value and write in the resulting value in the box marked "score SWM (Semmes-Weinstein monofilament)".



"Critical sites" for
median nerve and
ulnar nerve⁸

SENSORY FUNCTION- TACTILE GNOSIS

Discriminative touch



Static two-point discrimination (S2PD) ^{7,9}

Material

The Dellon-Mackinnon Disk Criminators™

Test procedure

The test results are initially inserted into the raw-data protocol.

The prongs on the Discriminator are applied longitudinally and perpendicular to the finger tips (digit II or V) with one or two prongs, 10 times randomly. The pressure should be applied until the skin is just blanching. Each distance should be applied 10 times in random order (one/two prongs), and 7 answers should be correct before proceeding to a lower distance. Demonstrate first how one and two prongs feel, and be careful to apply the two prongs simultaneously.

Start with 15 mm and then proceed to smaller distances (12, 10, 8 etc.). If the patient answers easily, one can proceed more quickly by omitting some distances. This is done to avoid fatigue. When the threshold for S2PD is approaching, testing should be done on each mm.

Scoring/quantification in Rosen score

- 0 = \geq 16 mm
- 1 = 11–15 mm
- 2 = 6–10 mm
- 3 = \leq 5 mm

Divide the score achieved (0–3) by the normal score (3) and insert the result in the box marked "Score S2PD digit II or V" in the Sensory domain.

SENSORY FUNCTION - TACTILE GNOSIS

The capacity to identify objects without the use of vision, which is one aspect of discriminative touch, can only be tested when the patient has some protective feeling at fingertip level, i.e. touch threshold measured with SWM at a minimum of 2 g (SWM no. 4.31). If the patient cannot feel filament no. 4.31, the score for discriminative touch in the Rosen score is 0.



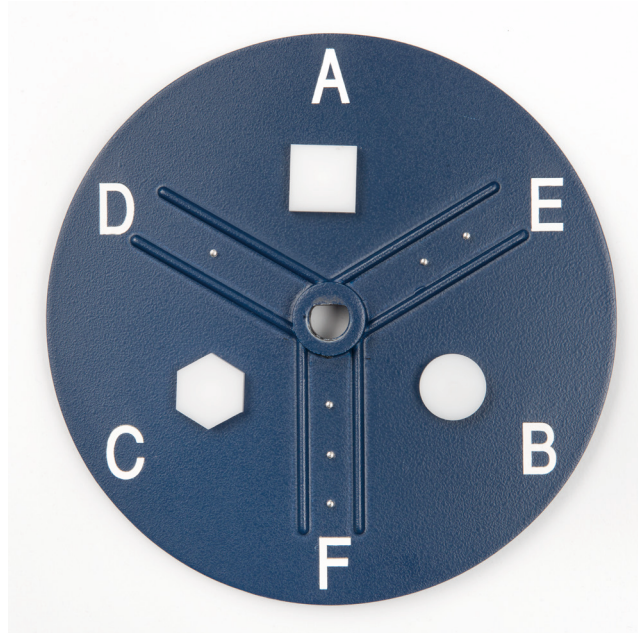
Shape Texture Identification (STI) test ^{2, 8-10}

Material

STI test
Screen

Test procedure

The test results are initially inserted into the raw-data protocol.



Step 1

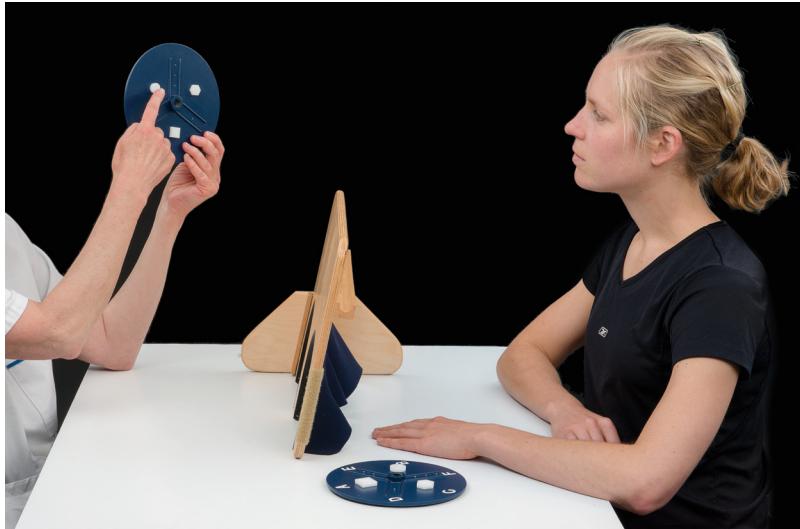
Always perform the test in the same order. Read out the following text marked in bold (but not the text in brackets) to the patient:

"You are now going to feel different shapes by touch (a cube, a cylinder, or a hexagon) **and simple textures."** (one, two or three small dots, 1 mm in diameter, and 0.5 mm in height, placed in a row). **"They are of varying degrees of difficulty, and your task is to identify them. You can see the shapes and textures in front of you now. There will always be one of each object and they will be presented at random. There is no time limit, so take your time when you touch them."**

"You are only allowed to use your index finger (median nerve injuries)/ **little finger** (ulnar nerve injuries), **and you are not allowed to use your nail."**

"Each item will be presented to you only once, and I will tell you the result when you have finished the test. When you think you can identify the object, tell me what it is or say A, B, C, D, E, or F."

(If the patient has a language problem or speech defect, he or she may point at the template disc).



Step 2

"Let's start with the three different shapes. The shapes look like this."
(Show the patient the disk with the 15-mm shapes). "There is a cube, a cylinder, and a hexagon, all 15 mm in diameter, one of each. Don't forget that you can take as much time as you need."



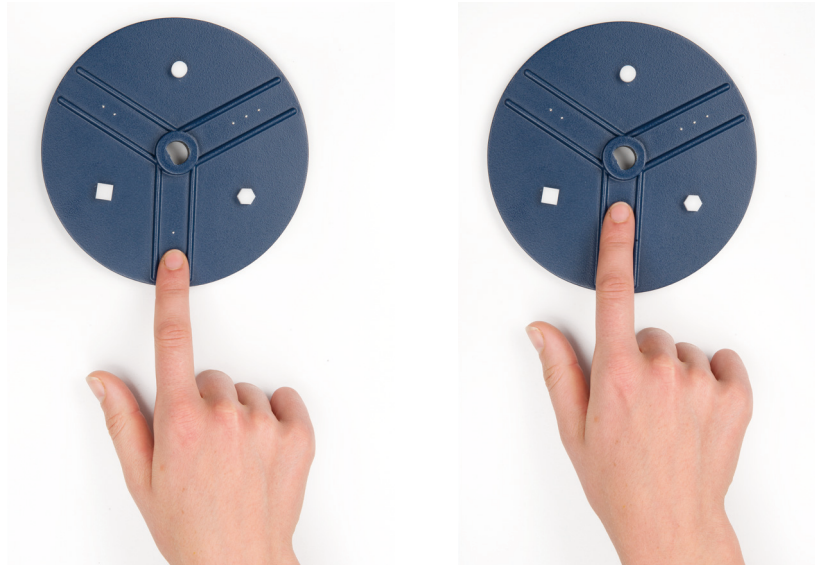
Step 3

"Let's start with your uninjured hand. Here is the first one...lift your finger... here is the second one...lift your finger...and here is the third."

"Let's continue with your injured hand. Here is the first one...lift your finger...here is the second one...lift your finger...and here is the third."

Steps 4 and 5

Repeat Step 3 with the smaller shapes (8 mm and 5 mm in diameter), using the same procedure.



6. "Now let's go to the three different textures. There are one, two, or three dots in a row." (Show the patient the disk with the dots 15 mm apart).

"You should move your finger along the track (demonstrate with your own finger) **all the way back and forth – as many times as you need. Don't forget that you mustn't use your nail and that you can take as much time as you need."**

Step 7

"Let's start with your uninjured hand. Here is the first one". (Make sure that the finger is in the middle of the track). **"Lift your finger...here is the second one...lift your finger...and here is the third."**

"Let's continue with your injured hand. Here is the first one...lift your finger...here is the second one...lift your finger...and here is the third."

Steps 8 and 9

Repeat Step 3 with the closer-placed dots (8 mm and 4 mm apart), using the same procedure.

Scoring/quantification in Rosen score

0 = 0–2 correct identifications

1 = 3 correct identifications

The maximum score for the complete test is 6

Quantification in Rosen score protocol:

Divide the score achieved (0–6) by the normal score (6) and insert the result in the box marked "score STI test digit II or V" in the Sensory domain.

SENSORY FUNCTION – DEXTERITY

Pulp pinch / Lateral pinch / Tripod chuck pinch



Mini Sollerman test^{3, 11}

Material

Mini Sollerman test or original Sollerman test – task nos. 4, 8, and 10.

The standardised Sollerman test contains 20 tasks based on the most common types of grip¹³.

Studies including patients with nerve injuries (median or ulnar nerve injuries) have shown that the results from 3 of the 20 tasks (4, 8, and 10) correlate strongly with the results from the full test with 20 tasks⁵.

Selected parts of the Sollerman hand function test (tasks 4, 8, and 10) are therefore included in the Mini Sollerman test, and are performed in accordance with the original instructions^{3,13}.

To prepare the three selected tasks from the Sollerman test, place two coins inside each purse of task 4 and keep the zippers open; unscrew all four bolts in task 8 and place them on the table. For task 10, undo all four buttons.

Test procedure

The test results are initially inserted into the raw-data protocol.

Each test is timed and performed in the following order: 4, 8, 10.

The patient is seated at a table and the test is placed in front of the patient.

The patient starts with each task when you say "start".

Optional choice of grip. Maximum time is 60 sec.

Scoring

4 points	The task was completed without any difficulty within 20 s and with the prescribed hand grip of normal quality
3 points	The task was completed, but with slight difficulty or The task was not completed within 20 s, but within 40 s or The task was completed with the prescribed hand grip with slight divergence from normal
2 points	The task was completed, but with great difficulty or The task was not completed within 40 s but within 60 s or The task was not performed with the prescribed hand grip
1 point	The task was only partially performed within 60 s
0 points	The task could not be performed at all within 60 s

Quantification in Rosen score

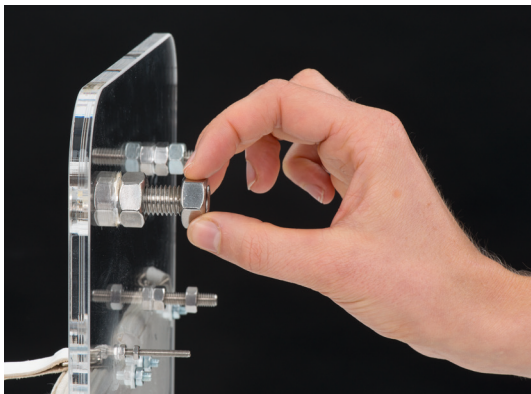
The quotient between the total score achieved (0–12) and the normal (12) score is calculated and inserted into the box marked "Score Sollerman test" in the Sensory domain.



Task 4:

"Pick up the coins (optional order), one at a time from the open purses and place them on the table."

Hand grip:
Pulp pinch



Task 8:

"Pick up the screw-nuts from the table, one at a time (optional order), and put them on the appropriate bolts (just so that they stay there)."

Hand grip:
Pulp pinch, Lateral pinch, Tripod
chuck pinch

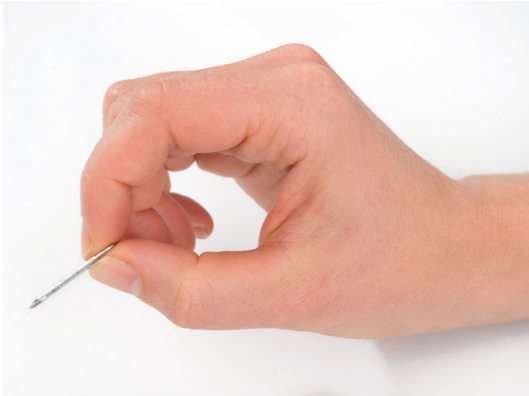


Task 10:

Position the buttons in front of the patient (see photograph). It is optional whether the biggest button is "up" or "down". "Button the four buttons (optional order) with one hand. You are allowed to stabilize the equipment with the untested hand."

Hand grip:
Pulp pinch, Lateral pinch

Grip type ¹³



Description

Pulp pinch:
The object is held between the thumb and the index and/or middle finger.



Tripod/Chuck pinch:
The object is surrounded by the thumb, the index finger, and the middle finger. It may have (but need not have) contact with the web of the thumb.



Lateral pinch:
The object is held between the thumb and the radial side of the index finger.

MOTOR FUNCTION – INNERVATION

Manual muscle test (MMT) 0–5 (Modified MRC scale¹²)

Material

A soft pillow to support the elbow/forearm

Test procedure

For median nerve injury, palmar abduction is tested, and for ulnar nerve injury, radial abduction dig II, abduction dig V, and adduction digit V are tested.

The test results are initially inserted into the raw-data protocol.

Quantification in Rosen score.

The summarised MMT results (median nerve 0–5; ulnar nerve 0–15) are divided by the “normal” score (5 and 15, respectively), and the quotient is inserted into the box marked “Score MMT” in the Motor domain.

The quotient between the score achieved (0–5 for median nerve and 0–15 for ulnar nerve) and the normal score (5 and 15, respectively) is calculated and inserted into the box marked “Score Manual muscle test (MMT)” in the Motor domain.

Median nerve



Abduction of the thumb (palmar abduction)

Primary muscle	M. abductor pollicis brevis.
Position	Forearm in supination, the wrist in 0–30° extension (neutral position).
Movement	Palmar abduction. The patient is asked to abduct the thumb in a plane perpendicular to the plane of the palm of the hand.
Resistance	Resistance, when indicated, is applied at the base of the thumb at the level of the MCP joint.
Grading/score	Manual muscle test (MMT) 0–5 0 = No activity 1 = Only palpable contraction 2 = Reduced movement, no resistance 3 = Normal movement, no resistance 4 = Normal movement, reduced resistance 5 = Normal movement, full resistance

Ulnar nerve



Radial abduction digit II

Primary muscle	M. interosseus dorsalis I.
Position	Forearm in neutral position. MCP II in slight flexion, IP joints dig II extended
Movement	The patient is asked to abduct the index finger.
Resistance	Resistance, when indicated, is applied at the base of the index finger.
Grading/score	Manual muscle test (MMT) 0–5 0 = No activity 1 = Only palpable contraction 2 = Reduced movement, no resistance 3 = Normal movement, no resistance 4 = Normal movement, reduced resistance 5 = Normal movement, full resistance

Ulnar nerve



Abduction digit V

Primary muscle	M. abductor digiti minimi.
Position	The examiner supports the patient's hand in supination. In this position, the tester is able to palpate the hypothenar muscles. In this way, the tester is able to judge for grade 0 or grade 1 in the case of severe paralysis, without having to change the test position.
Movement	The patient is asked to abduct the little finger with the IP joints straight and the MCP joint slightly flexed, to avoid trick movements from the extensor digiti minimi.
Resistance	Resistance, when indicated, is given at the base of the little finger.
Grading/score	Manual muscle test (MMT) 0–5 0 = No activity 1 = Only palpable contraction 2 = Reduced movement, no resistance 3 = Normal movement, no resistance 4 = Normal movement, reduced resistance 5 = Normal movement, full resistance

Ulnar nerve



Adduction digit V

Primary muscle	M. interosseus palmaris
Position	The forearm in supination with the hand and fingers supported. The MCP joint dig V should be held in neutral position.
Movement	The patient is asked to keep the little finger adducted against the ring finger.
Resistance	Resistance, when trying to separate the two fingers, is applied at the base of the little finger.
Grading/score	Manual muscle test (MMT) 0–5 0 = No activity 1 = Only palpable contraction 2 = Reduced movement, no resistance 3 = Normal movement, no resistance 4 = Normal movement, reduced resistance 5 = Normal movement, full resistance

MOTOR FUNCTION

Grip strength



Jamar dynamometer¹³

Material	Jamar dynamometer
Test procedure	
Grip strength	
Position	Seated with elbow close to waist, elbow joint in 90 degrees flexion, forearm in neutral position, wrist 0–30 degrees extension. The examiner supports the dynamometer.
Performance	Grip size in position 2. Start with the uninjured hand and shift between the uninjured and injured hand. Instruction: "Squeeze around the handle and press as hard as you can, a bit more, a bit more..., relax."
Method	Three measurements and calculation of the mean. The test results are initially inserted into the raw-data protocol.
Quantification in Rosen score	The quotient between the injured and uninjured hand (considered normal) is calculated and inserted into the box marked "Score Jamar dynamometer" in the Motor domain.

PAIN/DISCOMFORT³

Testprocedure

The test results are initially inserted into the raw-data protocol.

Ask the patient:

“Which of the following descriptions best describes your pain/discomfort problems from:”

“touch of the hand?”

“none/minor”, “moderate”, “disturbing”, “hinders activity”.

“cold?”

“none/minor”, “moderate”, “disturbing”, “hinders activity”.

Scoring/quantification in Rosen score

The chosen description is marked in the raw-data protocol.

0 = hinders activity

1 = disturbing

2 = moderate

3 = none/minor

The quotient between chosen description (0–3) and normal (3) is calculated and inserted into the box “Score Hyperaesthesia and Cold intolerance” in the Pain/discomfort domain.

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